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- Revision J 11/29/04 Pg 1 revised
- Revision K 06/02/05 Pg 3 revised, moved Caution Notes
- Revision L 09/02/05 Added A15 Reference

INSTRUCTION MANUAL IM117
For
GAS and STEAM TURBINE TENSIONED STUDS and NUTS

Fr.9E Turbine to 9H2 Generator GE358A7202P005, P014
Fr.9E Turbine to 9A4 (or 9A5) Generator GE358A7202P011, P015, P023
A15 Steam Turbine with 9A5 Generator (Cost Code U230)

| | | | |
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| GE Power Generation | | GENERAL ELECTRIC COMPANY Schenectady, NY | |
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**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator**

CAUTION

Personal injury and equipment damage can occur if the puller screw is not securely engaged with the tapered thread of the stud. Proper engagement is achieved when the puller screw is tight in the stud and the Tensioner Assembly is free to rotate.

WARNING

The safety cage MUST be in place and hands kept out of designated areas at all times when the puller tool is pressurized otherwise personal injury can occur.

CAUTION

DO NOT EXCEED THE MAXIMUM PRESSURE VIBROSCRIBED ON THE PULLER BODY. Excessive pressure can damage the stud and the puller screw.

WARNING

Fire Hazard; DO NOT heat when the puller assembly is in place. Personal injury or equipment damage may occur. Use of an Oxy-Acetylene torch is not recommended.

NOTICE

Do not use more thread locking compound than specified or the nut may be VERY difficult to remove at disassembly.

CAUTION

DO NOT EXCEED THE MAXIMUM PRESSURE VIBROSCRIBED ON THE PULLER BODY. Excessive pressure can damage the stud and puller screw

Note: Do not over extend the stud. Over extension can cause the piston to loose its seal and leak oil.

Note: Before inserting the puller screw into the tapered thread of the stud carefully clean both the male and female tapered threads and apply a high pressure lubricant such as “Never Seize” to the male taper. This procedure will ease assembly and assure positive mating of the threads before tightening.



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**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator**

1.0 Scope

This document describes the procedure to be used to install studs and nuts supplied by Riverhawk Company in the flanges at the turbine/coupling and coupling/generator connections. This hardware is depicted on the following drawings; these drawings as well as the tooling drawings form a part of this manual.

HF-0339, HF-0340, HF-0800, HF-0801, HF – 1098, HF-1785, HF-2848

2.0 General

Read and understand all instructions before installing studs.

This equipment produces very high hydraulic pressures and very high forces. Operators must exercise caution, wear safety glasses and hard hats when using this equipment.

High-pressure fluid from the Hydraulic Pressure Kit system pressurizes the tensioner, which generates a stretching force that actually stretches the stud. As the stud is stretched the nut lifts off the flange. The nut is then reseated into position on the flange by turning a nut driver by hand. When the nut is tight against the flange, the pressure in the tensioner is released leaving the stud loaded to its predetermined value.

2.1 Machine Preparation

The flange to be tensioned must be fully closed prior to positioning of studs in the flanges. There must be provision to turn the shafts of the turbine and the generator. Also, it will be advantageous to remove as many obstructions as possible from the flange area, such as speed probes and conduit.

2.2 Hardware – Balance

- Hardware is supplied as weight balanced sets
- Studs and Nuts are interchangeable within sets
- Do not mix with other sets
- Save the weight certification supplied with each set for the purchase of spares

2.3 Tensioner – Care and Handling

- When not in use, the tensioner shall be maintained in a clean environment and all caps and plugs for hydraulic openings and fittings must be in place.
- When in use, the tensioner shall be protected from sand and grit
- Long term storage – coat tensioner with oil, return to original container, seal container and protect from moisture
- Shipment – coat tensioner with oil and ship in original container



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**Instruction Manual IM117
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Fr.9E Turbine to 9H2 Generator
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2.4 Hand Tools

Several hand wrenches and micrometers will be required to perform installation and measurement of the studs:

- 5/8" wrench
- 1" wrench (box end)
- 1" Socket wrench
- 1/2" hex key wrench
- 3/16" hex key wrench
- 9" to 10" micrometer or caliper.

2.5 Special Tools

- Hydraulic Pressure Kit MP-0130 (hand pump) or AP-0532 (air driven, recommended)
- Hydraulic Tensioner Kit HT-0835, HT- 1278, HT-1786

3.0 Preparation of Hardware

3.1 Nut Preparation

For new installations, the nuts should come sealed from the factory and will need no cleaning.

Previously installed nuts require cleaning as follows: Wire brush using a petroleum based solvent to remove any foreign material on the external surfaces and threads.

If previous installations employed a thread-locking compound, which will be visible as a grayish-green residue, remove as much of this compound as possible.

Do not apply thread lubricants to the threads.

Finish the cleaning process by rinsing in a volatile solvent such as acetone and allow to dry.

3.2 Stud Preparation

For new installations, the studs should come sealed from the factory and will need no cleaning.

Previously installed studs require cleaning as follows: Wire brush using a petroleum based solvent to remove any foreign material on the shank and the threads.

If previous installation employed a thread-locking compound, which will be visible as a grayish-green residue, when the nut is removed, remove as much of this compound as possible.

Do not apply thread lubricants to the threads.



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**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator**

Finish the cleaning process by rinsing in a volatile solvent such as acetone and allow to dry.

3.3 Stud Length Measurement

Measure and record the initial lengths of the studs. The following recommendations will improve your results.

- Plan to start and finish any flange in the same day.**
- Studs and flange must be at the same temperature.**
- Number each stud with a marker.**
- Mark the location of measurement on stud end with a permanent marker.**
- Measure each stud to nearest 0.001 inch.**
- Record each measurement on the supplied charts.**
- Do not allow the measuring instruments to set in the sun.**

4.0 Stud and Nut Assembly

Refer to hardware assembly drawing (HF-) listed in section 1.0 of this manual. Assemble cylindrical nut to the tapered thread end (Pull End) of the stud. Slide the stud and cylindrical nut assembly into the flange as shown in Figure 1 and install the other nut on the backside. Adjust the nut/stud assembly so that the stud protrudes from the face of the cylindrical nut the amount as depicted on the hardware drawing (HF-). **SETTING THIS PROTRUSION OF STUD TO NUT IS CRITICAL FOR PROPER TENSIONER OPERATION. A metal stickout gage is provided with the tensioner to assist the operator in setting the protrusion dimension (See Fig 6). Hand tighten the assembly to a snug fit. Reference Section 11.0.** See photos 1 & 2 for view of studs in flange prior to tensioning.

5.0 Assembly of Hydraulic Tensioner Equipment:

5.1 Kit Assembly

Assemble the hydraulic pump with its hose to the puller tool and bleed the system of air per following instructions. Photo 4 shows hose connected to manifold of tensioner.

5.1.1 Fittings

Make sure both male and female parts are clean and free of debris; see Figure 3 for fitting configuration. Hold female part securely when tightening so as to prevent damage to adjacent tubing. If fitting leaks first try retightening as needed. If leaking continues then disassemble and check for scratches or debris on the seating conical surfaces. Clean as required. Replace plastic caps when finished with tooling.

5.2 Pump

The pump kit is shipped full of hydraulic oil. The pump reservoir cap is sealed for shipment. To use turn cap to the vent position. To prevent oil spillage close cap when not in use, during storage and shipment.



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| FIRST MADE FOR: | SH. |

**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator**

Lost oil should be replaced with Enerpac Hydraulic Oil. ISO 32. Mineral Oil may be substituted, if necessary.

5.3 Bleeding Hydraulic System

Follow the tensioner assembly instructions of Section 6.0

TO AVOID FAILURE, ENSURE SAFETY AND PROPER OPERATION THE TENSIONER ASSEMBLY MUST BE MOUNTED ON THE STUD BEFORE BLEEDING THE SYSTEM AND TENSIONING BEGINS.

The tensioner has four ports see Fig. 5, one for pressurizing, two for bleeding the system and a fourth pressure relief port.

To facilitate bleeding, start by first mounting the tensioner at either the 3 o'clock or 9 o'clock stud position depending on which will critically place the bleed ports in their uppermost position. In addition, make sure that the pump is always situated below the tensioner assembly.

The puller tool is equipped with 5/8 in. Hex coned stem bleeder fittings installed in the bleeder ports. With these two fittings loosened simultaneously, stroke the pump repeatedly until the streams of oil exiting the tool from each port are free of air, then retighten the fittings.

Providing that the hose is not disconnected or loosened in the process of tensioning all the studs, bleeding the assembly once at the first position should suffice to fill the assembly and preclude the need to repeat the bleeding process.

Note: The hose is stiff; use of this tooling can be simplified by temporarily mounting the puller tool on one stud prior to final tightening of fittings. This will reduce the tendency for the fittings to loosen during use.

6.0 Assembly of Tensioner on Stud

All tensioning will be performed from the tapered thread end of the stud with orientation of the stud to the flange as shown in Figures 1. Refer to Tensioner assembly drawing and Figure 5 for tensioner to flange mounting.

This assembly has the following features, which should make stud tensioning safe and easy.

- The safety cage is integral (bolted) to the puller tool
- The hydraulic piston is spring loaded to retract.

Assembly sequence is as follows:



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**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator**

- **Open the hydraulic return valve on the hand pump to allow hydraulic fluid to be pushed back from the puller tool into the pump reservoir (not required with air driven pump).**
- Place the spanner ring on the puller side cylindrical nut
- Place and hold the tensioner assembly over the end of the stud to be tightened. See photos 3,4 &5.
- Slide the puller screw in to the tapered thread of the stud and hand tighten. **Be sure not to cross thread assembly.**
- Tighten the puller screw using Allen wrenches on the puller screw and the stud. **DO NOT** wrench on the Hex nut opposite the puller tool.
- At this point the Tensioner Assembly **MUST BE FREE TO ROTATE** and the puller screw must be tight in the stud.

If the puller tool is not free to rotate when the puller screw is tight, then the stud is not properly positioned in the flange and the nuts must be repositioned so that the stud is shifted slightly more on the puller tool side. This can be done as follows.

- Slightly loosen the puller screw
- Back the nut opposite the puller tool off about 1/2 turn
- Tighten the puller screw side nut to take up the slack.
- Retighten the puller screw per above and check for looseness of tool

NOTE: Do not over extend the stud. Over extension can cause the piston to loose its seal and leak oil

CAUTION

Personal injury and equipment damage can occur if the puller screw is not securely engaged with the tapered thread of the stud. Proper engagement is achieved when the puller screw is tight in the stud and the Tensioner Assembly is free to rotate.

7.0 Stud Pulling and Tensioning

The studs will be tensioned in two steps, at approximately 50% pressure and at final pressure. Follow the tensioning sequence for each flange joint as defined on the data sheets found at the end of this manual

Note: Before inserting the puller screw into the tapered thread of the stud carefully clean both male and female tapered threads and apply a high pressure lubricant such as “Never Seize” to the male taper. This procedure will ease assembly and assure positive mating of the threads before tightening.

WARNING



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| GE DRAWING NUMBER | REV. |
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**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator**

The safety cage MUST be in place and hands kept out of designated areas at all times when the puller tool is pressurized otherwise personal injury can occur.

7.1 Tensioning at 50% pressure

After the tensioner is properly installed apply hydraulic pressure to the tool. Bring the pressure to the 50% level in accordance with the following table.

| Flange | Stud Diameter | 50% Pressure |
|------------------------------------|----------------------|---------------------|
| Turbine/Coupling | 2.784 in. | 8000 psi |
| Coupling(Steam Turbine) /Generator | 2.784 in. | 8000 psi |

7.1.1 Turn the cylindrical nut using the spanner ring and pinwrench as depicted in Figure 5 until it bottoms on the flange.

7.2 Puller Tool Removal

Puller tool removal is to accomplished as follows:

- Release the puller tool pressure by opening the valve on the pump. Leave the valve open.
- Unscrew the puller screw using a wrench
- Tapping the wrench with a hammer may be necessary to loosen the puller screw.
- Move the tool to the next stud/nut assembly to be tensioned, following the sequence/pattern as defined on the supplied data sheet.

7.3 Tensioning at Final Pressure

Repeat the pulling and tightening procedure stated above at full pressure. Measures the length of the studs after all have been tensioned. The final pressure and required stretch values are listed in the following table

| Flange | Stud Diameter | Stretch | Final Pressure |
|--------------------|----------------------|----------------|-----------------------|
| Turbine/Coupling | 2.784 in. | .011/.013 in. | 16000 psi |
| Coupling/Generator | 2.784 in. | .011/.013 in. | 16000 psi |

CAUTION

**DO NOT EXCEED THE MAXIMUM PRESSURE VIBROSCRIBED ON THE PULLER BODY.
Excessive pressure can damage the stud and the puller screw.**



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| GE DRAWING NUMBER | REV. |
| 373A4003 | C |
| FIRST MADE FOR: | SH. |

**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator**

8.0 Retensioning

For the procedures of Section 7.3 excessive stretch variation or low stretch values can be corrected by re-tensioning all or selected studs to the pressure values stated in the above table. Have final stretch values approved by the supervisor responsible for the installation.

9.0 Thread Locking

Once pulling and tensioning is complete all studs and nuts must be locked in position. The lock nuts used in the turbine/coupling and coupling/generator connections employ a mechanical locking feature. These mechanical lock nuts have two set screws located on the top face, see Figure 4.

Before threading the nut onto the stud check to be certain that the set screws are free to turn. Once the nut is seated torque the set screws to the values specified in the following table. When seated and torqued to the values specified the load created by the set screw displaces the thread of the nut in the area of the web creating the desired locking action.

| Nut Diameter in. | Set Screw Size | Seating Torque in. lbs. |
|------------------|----------------|-------------------------|
| 2 3/4 | 3/8 –24 | 200 to 250 |

10.0 Stud/Nut Removal

Removal is accomplished as follows:

Using a wire brush and shop air clean the internal tapered thread of the stud to remove any debris/deposits, which may have accumulated during service. With an Allen-wrench loosen the two locking set screws but do not remove from the nut see Figure 4. Install the appropriate puller tool to the stud as described in Section 6.0. Apply the appropriate hydraulic pressure per the following Table and using the spanner ring and spanner/pin wrenches shown in Figure 5 loosen the nut, then release the pressure and remove the puller tool.

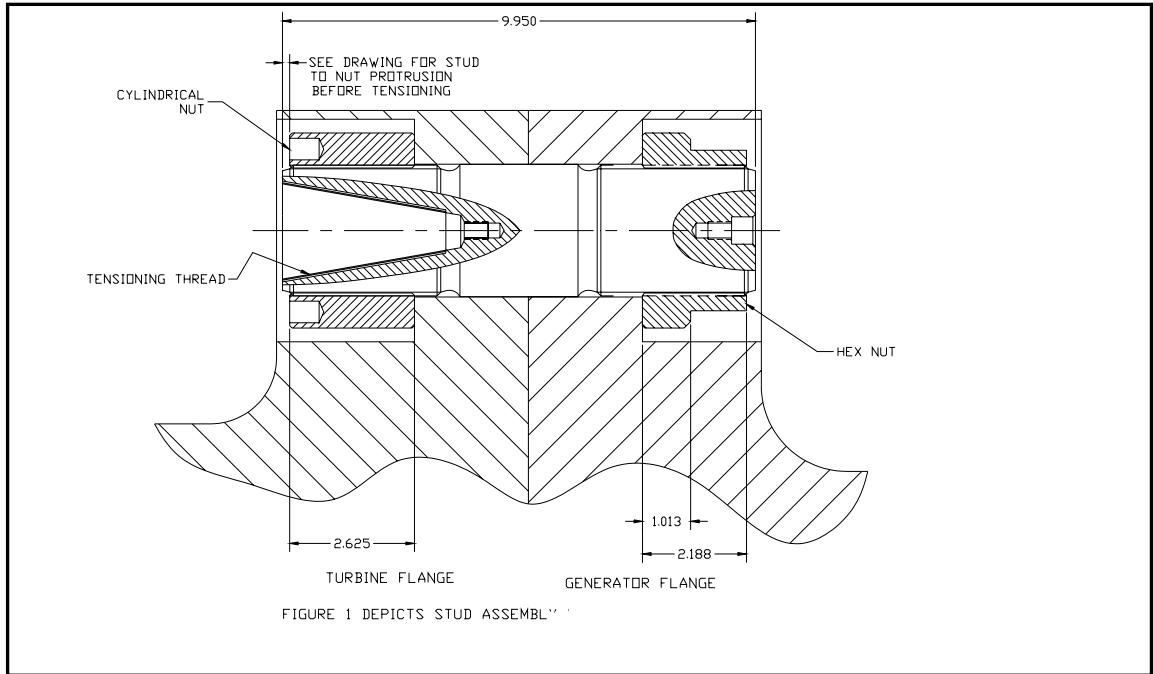
| Location | Nut Size | Puller Pressure |
|--------------------|-----------|-----------------|
| Turbine/Coupling | 2.784 in. | 16000 psi |
| Coupling/Generator | 2.784 in | 16000 psi |



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Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator

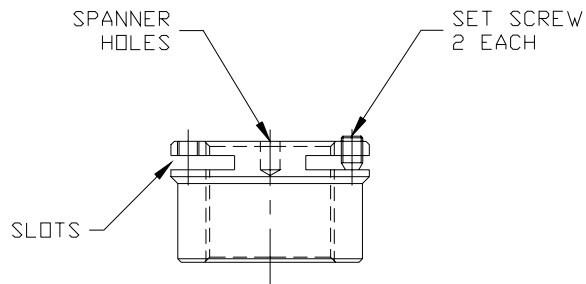
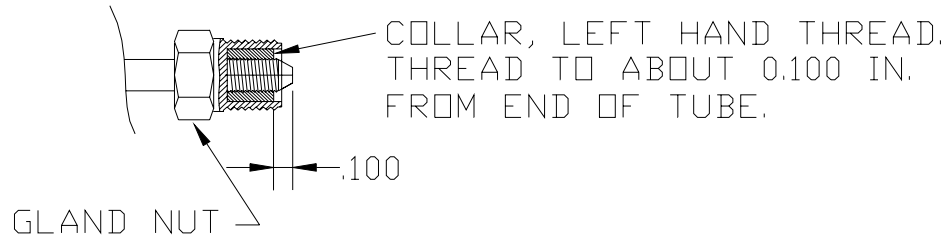


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Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
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FIGURE 3 PRESURE PORT



TYPICAL STUD LOCKNUT
 FIGURE 4



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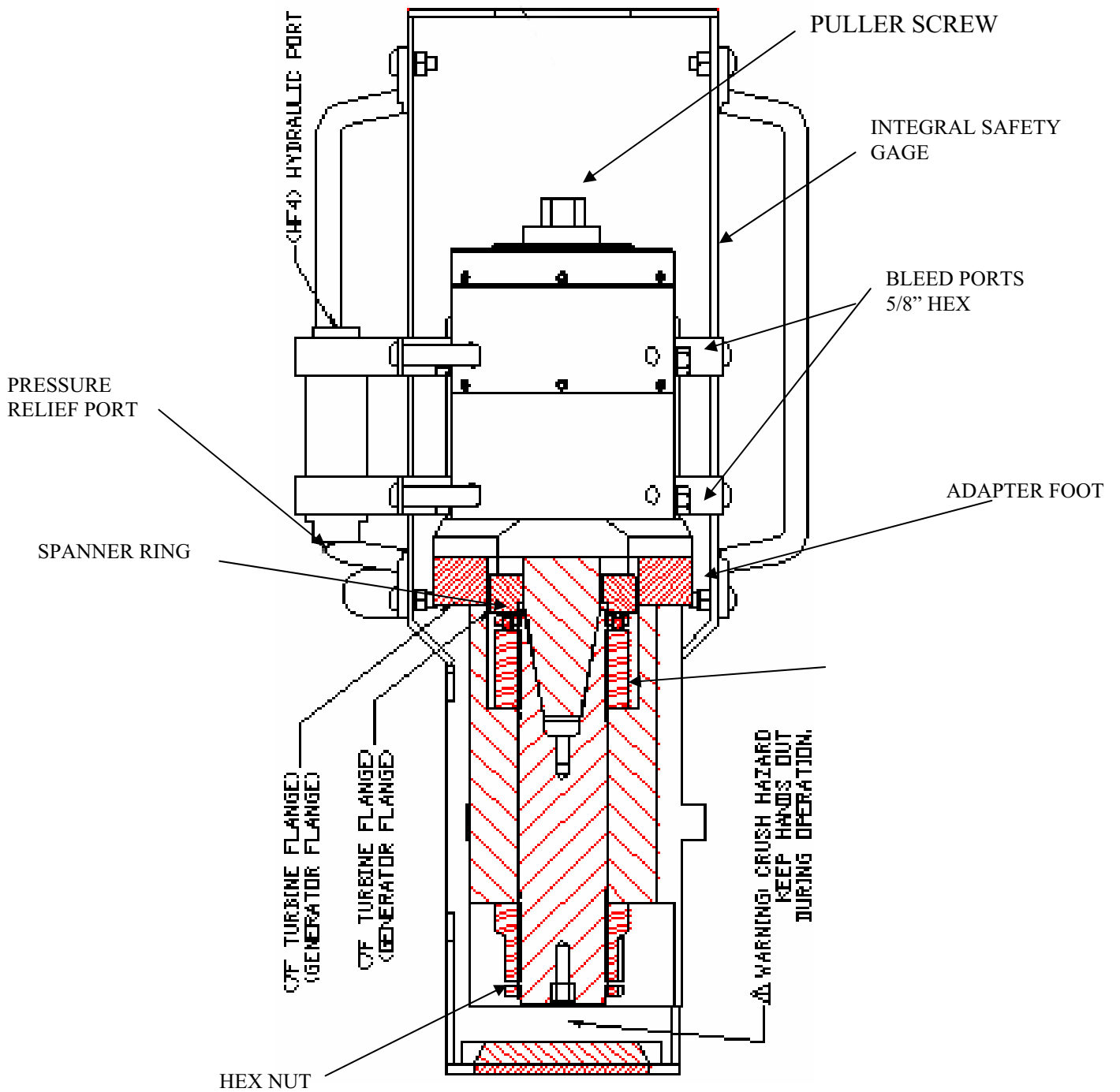


FIGURE 5



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 Gas Turbine Tension Studs & Nuts
 Fr.9E Turbine to 9H2 Generator
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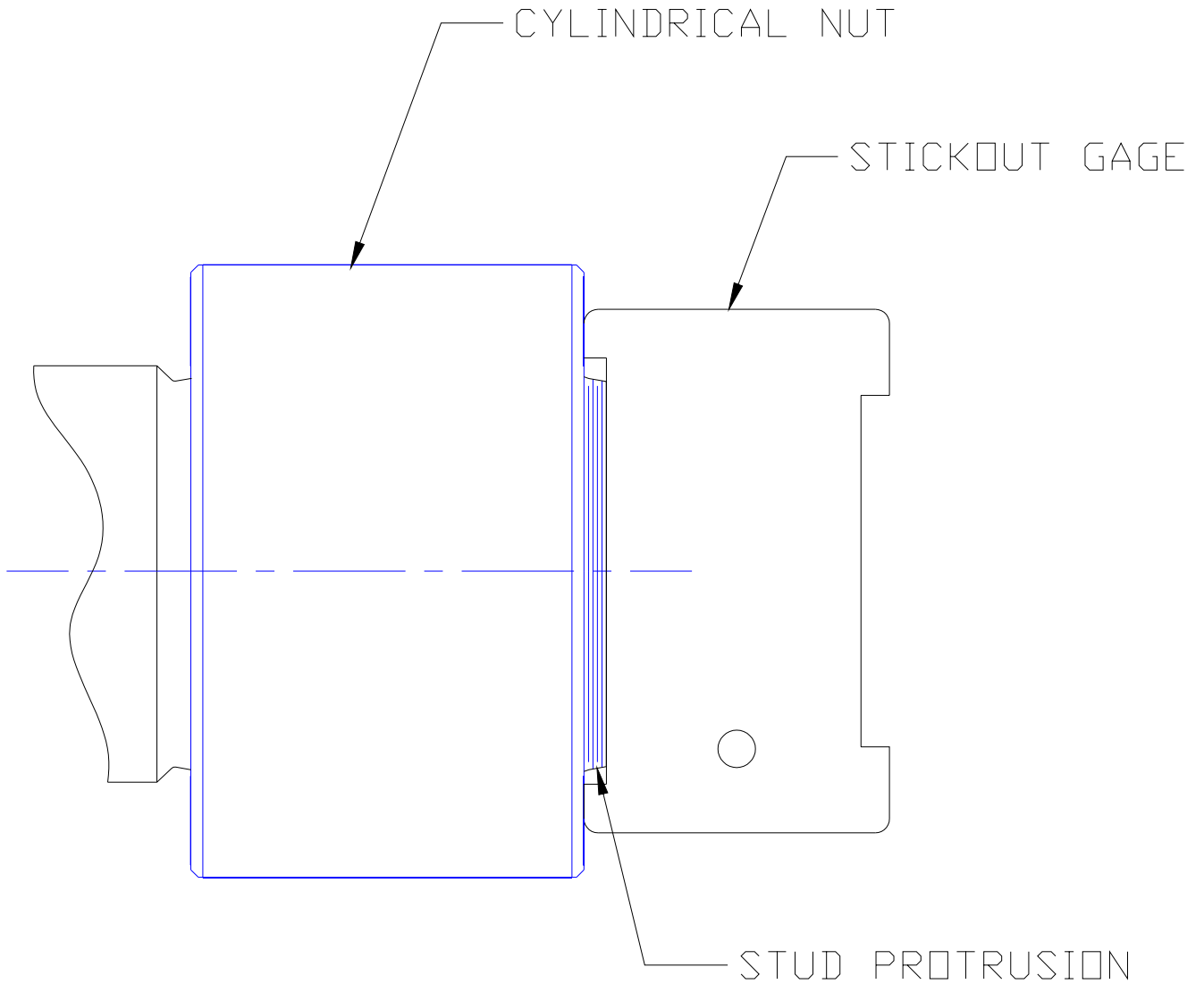


FIGURE 6



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**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
A15 Steam Turbine with 9A5 Generator**



Photo 1
Section of 9FA turbine flange with
studs in place prior to tensioning.



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**Instruction Manual IM117
 Gas Turbine Tension Studs & Nuts
 Fr.9E Turbine to 9H2 Generator
 A15 Steam Turbine with 9A5 Generator**



Photo 2
 Back side of 9FA turbine
 flange showing studs and nuts
 in place.



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**Instruction Manual IM117
 Gas Turbine Tension Studs & Nuts
 Fr.9E Turbine to 9H2 Generator
 A15 Steam Turbine with 9A5 Generator**



Photo 3
 Side view of tensioner mounted
 on 9FA turbine flange.



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**Instruction Manual IM117
Gas Turbine Tension Studs & Nuts
Fr.9E Turbine to 9H2 Generator
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Photo 4
Tensioner in operation while
mounted on 9FA turbine
flange.



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Photo 5
Tensioner in operation while
mounted on 9FA turbine
flange.

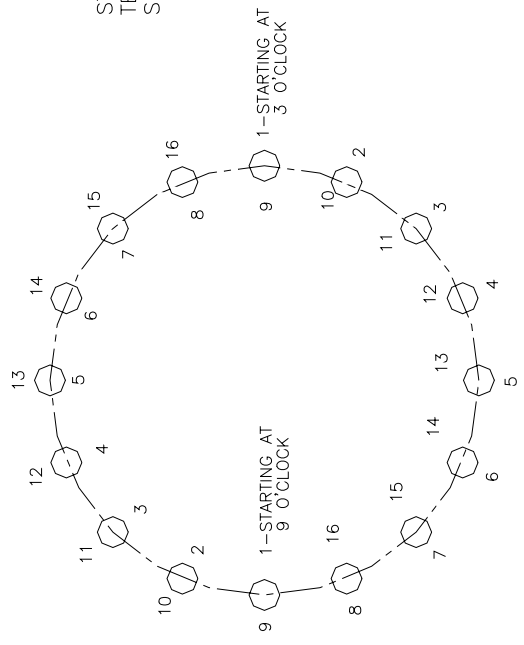


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1 2 3 4

STRETCH RECORD SHEET FOR (16) STUD PATTERN



| STUD TENSIONING SEQUENCE | ORIGINAL LENGTH | FIRST PULL LENGTH (1) | STRETCH (1) | SECOND PULL LENGTH (2) | STRETCH(2) |
|--------------------------|-----------------|-----------------------|-------------|------------------------|------------|
| 1 | ----- | ----- | ----- | ----- | ----- |
| 2 | ----- | ----- | ----- | ----- | ----- |
| 3 | ----- | ----- | ----- | ----- | ----- |
| 4 | ----- | ----- | ----- | ----- | ----- |
| 5 | ----- | ----- | ----- | ----- | ----- |
| 6 | ----- | ----- | ----- | ----- | ----- |
| 7 | ----- | ----- | ----- | ----- | ----- |
| 8 | ----- | ----- | ----- | ----- | ----- |
| 9 | ----- | ----- | ----- | ----- | ----- |
| 10 | ----- | ----- | ----- | ----- | ----- |
| 11 | ----- | ----- | ----- | ----- | ----- |
| 12 | ----- | ----- | ----- | ----- | ----- |
| 13 | ----- | ----- | ----- | ----- | ----- |
| 14 | ----- | ----- | ----- | ----- | ----- |
| 15 | ----- | ----- | ----- | ----- | ----- |
| 16 | ----- | ----- | ----- | ----- | ----- |

MACHINE _____
 FLANGE _____
 DATE _____
 TECHNICIAN _____
 SUPERVISOR _____

AVG. STRETCH UNITS in. mm, CIRCLE ONE ---
 AVG. STRETCH UNITS in. mm, CIRCLE ONE ---

NOTE: START TENSIONING SEQUENCE AT EITHER THE 3 O'CLOCK OR 9 O'CLOCK POSITION DEPENDING ON WHICHEVER POSITION PLACES THE BLEED PORT OF THE TENSIONER ASSEMBLY IN THE UPPERMOST POSITION.

| | |
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| MATERIAL: | TORQUE PATTERN FOR (16) STUDS |
| DWG: _____ | REV: _____ |
| DATE: 03/24/99 | DATE: 03/24/99 |
| ENG. APPROVAL: AHC | SCALE: _____ |
| SIZE: _____ | DWG NO.: 990324-01 |
| NO. _____ | SHEET _____ |

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| FIRST MADE FOR: | SH. |